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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:
Terunao HANAOKA
Serial No.: 10/802,668
Confirmation No.: 2671
Filed: March 17, 2004
For: Semiconductor Device and Method for
Manufacturing The Same, Circuit
Board and Electronic Equipment

**TRANSMITTAL OF VERIFIED TRANSLATION OF
PRIORITY DOCUMENT**

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Enclosed herewith is a certified copy of the verified English translation of priority document Japanese Patent Application No. 2003-073925, filed March 18, 2003, from which priority is claimed under 35 U.S.C. § 119 and Rule 55.

Acknowledgment of the priority document(s) is respectfully requested to ensure that the subject information appears on the printed patent.

Respectfully submitted,
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I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to:

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VERIFICATION OF TRANSLATION

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Sir:

Masakatsu Saka residing at 3-3-5 Owa, Suwa City, Nagano-ken 392-8502, Japan
declares:

- (1) that he knows well both the Japanese and English languages;
- (2) that he translated the Japanese document entitled "SEMICONDUCTOR DEVICE AND METHOD FOR MANUFACTURING THE SAME, CIRCUIT BOARD AND ELECTRONIC EQUIPMENT" from Japanese to English;
- (3) that the attached English translation is a true and correct translation of the above-identified Japanese document to the best of his knowledge and belief; and
- (4) that all statements made of his own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements are made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 USC 1001, and that such false statements may jeopardize the validity of the application or any patent issuing thereon.

Dated: September 5, 2005

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[List of Documents Attached]

[Name of Document] Specification 1

[Name of Document] Drawings 1

[Name of Document] Abstract 1

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[Proof] Required

[Document] Specification

[Title of the Invention]

SEMICONDUCTOR DEVICE AND METHOD FOR MANUFACTURING
THE SAME, CIRCUIT BOARD AND ELECTRONIC EQUIPMENT

[CLAIMS]

What is claimed is:

1. A semiconductor device, comprising:
 - a semiconductor substrate including an integrated circuit and an electrode;
 - a resin layer provided on a side of the semiconductor substrate where the electrode is formed; and
 - a wiring formed on an area reaching from the electrode to a top of the resin layer,

wherein the electrode has a first rim part facing a periphery of the semiconductor substrate and a second rim part facing a center of the semiconductor substrate, and

wherein the resin layer is formed so as to overlap the second rim part, leaving out an area from the periphery of the semiconductor substrate to the first rim part of the electrode.
2. The semiconductor device according to Claim 1, wherein a passivation film having an opening which exposes part of the electrode is formed on the side of the semiconductor substrate where the electrode is formed, and the resin layer is formed on the passivation film.
3. The semiconductor device according to Claim 2, wherein the resin layer is formed leaving out a part exposed by the opening of the electrode.
4. The semiconductor device according to Claim 2 or 3, wherein a center of the opening is positioned so as to deviate from a center of the electrode towards the periphery of the semiconductor substrate.
5. A circuit board, where the semiconductor device according to any one of Claims 1 through 4 is mounted.

6. Electronic equipment, having the semiconductor device according to any one of Claims 1 through 4.

7. A method for manufacturing a semiconductor device, comprising:
forming a resin layer on a side of the semiconductor substrate having an electrode and an integrated circuit where the electrode is formed; and
forming a wiring on an area reaching from the electrode to a top of the resin layer,

wherein the electrode has a first rim part facing a periphery of the semiconductor substrate and a second rim part facing a center of the semiconductor substrate, and

wherein the resin layer is formed so as to overlap the second rim part, leaving out an area from the periphery of the semiconductor substrate to the first rim part of the electrode.

8. The method for manufacturing a semiconductor device according to Claim 7, further comprising:

forming a passivation film having an opening which exposes part of the electrode on the side of the semiconductor substrate where the electrode is formed, and

forming the resin layer on the passivation film.

9. The method for manufacturing a semiconductor device according to Claim 8, further comprising:

forming the resin layer leaving out a part exposed by the opening of the electrode.

10. The method for manufacturing a semiconductor device according to Claim 8 or 9, further comprising:

positioning a center of the opening so as to deviate from a center of the electrode towards the periphery of the semiconductor substrate.

[Detailed Description]**[Field of the Invention]****[0001]**

The present invention relates to a semiconductor device, a method for manufacturing the same, a circuit board and electronic equipment.

[Description of the Related Art]**[0002]**

CSPs (chip scale/size packages) have been widely used as semiconductor device packages. Further, the technology for manufacturing packages at the wafer level (wafer level packages) is being developed. With packages manufactured by this method (for example wafer level CSPs), the outer dimensions determine the dimensions of the semiconductor chip, and it is therefore important to increase the mountability by increasing wiring flexibility.

[Problems to Be Solved]**[0003]**

The present invention is intended to provide a semiconductor device with high mountability and high reliability, and a method for manufacturing the same, a circuit board and electronic equipment.

[Means to Solve the Problems]**[0004]**

(1) A semiconductor device according to one aspect of the present invention includes a semiconductor substrate having an integrated circuit and an electrode, a resin layer provided on the side of the semiconductor substrate where the electrode is formed, a wiring formed on an area reaching from the electrode to the top of the resin layer. The electrode has a first rim part facing the periphery of the semiconductor substrate, and a second rim part facing the center of the semiconductor substrate. The resin layer is formed so as to overlap the second rim part, leaving out the area from the periphery of the semiconductor substrate to the first rim part of the electrode. According to the present invention, the resin layer is designed to overlap part of the electrode. Therefore, it becomes possible to form the resin layer in close proximity to the electrically conductive part

of the electrode, and thus a large surface is available for the resin layer. Further, the resin layer is not formed in the periphery region out of the electrode. Therefore, even if the resin layer is formed in the proximity of the electrically conductive part of the electrode, it can be prevented that the resin layer is placed on the electrically conductive part of the electrode because of contraction of the resin. Therefore, a semiconductor device with high mountability and highly reliable electrical connectivity can be provided.

(2) In the semiconductor device, a passivation film having an opening which exposes part of the electrode can be formed on the side of the semiconductor substrate where the electrode is formed. The resin layer can be formed on the passivation film.

(3) In this semiconductor device, the resin layer can be formed leaving out a part exposed by the opening of the electrode. In this way, the resin layer is not placed on the electrically conductive part of the electrode. Therefore, a semiconductor device with highly reliable electrical connectivity can be provided.

(4) In this semiconductor device, the center of the opening can be positioned so as to deviate from the center of the electrode towards the periphery of the semiconductor substrate. Accordingly, as a larger surface is available for the resin layer, a semiconductor device with high wiring flexibility can be provided.

(5) On a circuit board according to another aspect of the present invention, the above-mentioned semiconductor device is mounted.

(6) Electronic equipment according to another aspect of the present invention includes the above-mentioned semiconductor device.

(7) A method for manufacturing a semiconductor device according to another aspect of the present invention includes forming a resin layer on the side of the semiconductor substrate having an electrode and an integrated circuit where the electrode is formed, and forming a wiring on an area reaching from the electrode to the top of the resin layer. The electrode has a first rim part facing the periphery of the semiconductor substrate, and a second rim part facing the center of the semiconductor substrate. The resin layer is formed so as to overlap the second rim part, leaving out the area from the periphery of the

semiconductor substrate to the first rim part of the electrode. According to the present invention, the resin layer is formed so as to overlap part of the electrode. Therefore, it becomes possible to form the resin layer in close proximity to the electrically conductive part of the electrode, and thus a large surface is available for the resin layer. Further, the resin layer is not formed in the periphery region out of the electrode. Therefore, even if the resin layer is formed in the proximity of the electrically conductive part of the electrode, it can be prevented that the resin layer is placed on the electrically conductive part of the electrode because of contraction of the resin. Therefore, a semiconductor device with high mountability and highly reliable electrical connectivity can be provided.

(8) In this method for manufacturing a semiconductor device, a passivation film having an opening which exposes part of the electrode can be formed on the side of the semiconductor substrate where the electrode is formed. The resin layer can be formed on the passivation film.

(9) In this method for manufacturing a semiconductor device, the resin layer can be formed leaving out a part exposed by the opening of the electrode. Thereby, the resin layer is not placed on the electrically conductive part of the electrode. Therefore, a semiconductor device with highly reliable electrical connectivity can be provided.

(10) In this method for manufacturing a semiconductor device, the center of the opening can be positioned so as to deviate from the center of the electrode towards the periphery of the semiconductor substrate. Accordingly, as a larger surface is available for the resin layer, a semiconductor device with high wiring flexibility can be provided.

[DESCRIPTION OF THE PREFERRED EMBODIMENT]

[0005]

Following is an explanation of embodiments of the present invention with reference to the drawings. However, the present invention is not limited to the below mentioned embodiment. FIG. 1 is a sectional view of a semiconductor device according to an embodiment of the present invention. FIG. 2 is a top view of the semiconductor device of the present embodiment without a wiring 40, a resist layer 50, a coat layer 60 and an external terminal 46.

[0006]

The semiconductor device has a semiconductor substrate 10. The semiconductor substrate 10 can be a semiconductor chip or a semiconductor wafer. On the semiconductor substrate 10, at least one integrated circuit 12 is formed. On a semiconductor chip one integrated circuit 12 is formed, whereas on a semiconductor wafer more than one integrated circuit 12 is formed. The semiconductor substrate 10 has a plurality of electrodes (for example pads), each of which are hereinafter referred to as an electrode 14. The electrode 14 can be made of Al. The electrode 14 can be electrically connected to the integrated circuit 12. Or, an electrode that is not electrically connected to the integrated circuit 12 can be used as the electrode 14. The electrode 14 has a first rim part 15 facing the periphery of the semiconductor substrate 10, and a second rim part 16 facing the center of the semiconductor substrate 10. Furthermore, the electrode 14 includes an intermediate part 17 flanked by the first rim part 15 and the second rim part 16.

[0007]

A passivation film 20 can be formed on the side of the semiconductor substrate 10 where the electrode 14 is formed. In this case, the passivation film 20 has an opening 22 which exposes part of the electrode 14. The passivation film 20 can be formed so that the opening 22 is located at the intermediate part 17 of the electrode 14. Further, the passivation film 20 can be positioned so as to make the center of the opening 22 deviate from the center of the electrode 14 towards the periphery of the semiconductor substrate 10. The passivation film 20 can be made of SiN, SiO₂, polyimide resin, and the like.

[0008]

The semiconductor device includes a resin layer 30. The resin layer 30 is designed on the side of the semiconductor substrate 10 where the electrode 14 is formed. The resin layer 30 is formed so as to overlap the second rim part 16 of the electrode 14, leaving out the area from the periphery of the semiconductor substrate 10 to the first rim part 15 of the electrode 14. The resin layer 30 can be formed leaving out the middle part of the intermediate part 17 of the electrode 14. The resin layer 30 can be formed so as to overlap a rim part 19 of the intermediate part 17 of the electrode 14. Or, the resin layer 30 can be formed so as to not overlap the rim part 19. In the case where the semiconductor substrate 10 has the

passivation film 20, the resin layer 30 is formed on the passivation film 20. And, the resin layer 30 overlaps the second rim part 16, with the passivation film 20 therebetween. In this case, the resin layer 30 can be formed leaving out an exposed part 18 exposed by the opening 22 of the passivation film 20 of the electrode 14. The resin layer 30 can have stress relaxation properties. The resin layer 30 can be made of a resin such as polyimide resin, silicone modified polyimide resin, epoxy resin, silicone modified epoxy resin, benzocyclobutene (BCB), and polybenzoxazole (PBO). The resin layer 30 can be formed between the semiconductor substrate 10 and an external terminal 46.

[0009]

As explained above, the resin layer 30 of the semiconductor device according to the present embodiment is designed so as to overlap part of the electrode 14. Therefore, it becomes possible to form the resin layer 30 in close proximity to the electrically conductive part (for example the exposed part 18) of the electrode 14. Therefore, more area of the resin layer 30 is available, and thereby increasing wiring flexibility. Further, the resin layer 30 is not formed in a periphery region out of the electrode 14 (more specifically, the region reaching from the periphery of the semiconductor substrate 10 to the first rim part 15 of the electrode 14). Therefore, even in the case of contraction of the resin, it can be prevented that the resin layer 30 is placed on the electrically conductive part of the electrode 14, and the reliability of the electrical connectivity can be increased. In other words, according to the present invention, a semiconductor device can be provided featuring high mountability and highly reliable electrical connectivity. Furthermore, with the passivation film 20 being positioned so as to make the center of the opening 22 deviate from the center of the electrode 14 towards the periphery of the semiconductor substrate 10, a larger surface is available for the resin layer 30, and as a result a semiconductor device with an excellent mountability can be provided.

[0010]

The semiconductor device includes at least one wiring 40. Each wiring 40 can be composed of one layer or a plurality of layers. The wiring 40 can also cover the whole part of the exposed part 18 exposed by the opening 22 of the electrode 14. The wiring 40 is formed so as to reach

from the electrode 14 to the top side of the resin layer 30 (the side opposite of the side of the passivation film 20). As shown in FIG. 1, the wiring 40 can be formed so as to pass by a lateral side of the resin layer 30.

[0011]

The semiconductor device can have a plurality of external terminals 46. The external terminals 46 are electrically connected to the wiring 40. The external terminals 46 can be formed on a land 48 of the wiring 40. The external terminals 46 are made of a conductive metal (for example an alloy) that is melted to be electrically connected (for example solder). The external terminals 46 may consist of either soft solder or hard solder. The external terminals 46 can be of spherical shape, for example, they can be solder balls.

[0012]

The semiconductor device can include a resist layer 50. The resist layer 50 covers at least part of the wiring 40. By covering the whole part of the wiring 40 with the exception of the part designated for the external terminals 46 with the resist layer 50, the oxidation or corrosion of the wiring 40 can be prevented, and thus resulting electrical defects. The resist layer 50 can be formed sparing at least the center part of the land 48 of the wiring 40. The resist layer 50 can also cover the periphery part of the land 48.

[0013]

The semiconductor device can include a coat layer 60. The coat layer 60 can be formed on the resist layer 50. The coat layer 60 can be formed so as to cover the base part (lower rim part) of the external terminals 46. The coat layer 60 can include one part formed on the resist layer 50 and another part rising from the one part and covering the base part of the external terminals 46 (see FIG. 1). The coat layer 60 allows to reinforce at least the base part of the external terminals 46. Therefore, after the semiconductor device has been mounted on the circuit board, the coat layer 60 helps to disperse stress concentrations on the external terminals 46.

[0014]

If the semiconductor substrate 10 is a semiconductor chip, the package size of the semiconductor device is almost equal to the size of the

semiconductor chip and the semiconductor device can be classified as a CSP. It can also be called a flip chip with stress relaxation properties.

[0015]

The semiconductor device according to the present embodiment is formed as explained above, and in the following, the corresponding manufacturing method will be explained. The method for manufacturing a semiconductor device according to the present embodiment includes forming the resin layer 30 on the semiconductor substrate 10 including the integrated circuit 12 and the electrode 14. The resin layer 30 is formed on the side of the semiconductor substrate 10 where the electrode 14 is formed. Further, the electrode 14 has the first rim part 15 facing the periphery of the semiconductor substrate 10, and the second rim part 16 facing the center of the semiconductor substrate 10. Further, the electrode 14 can have the intermediate part 17 flanked by the first rim part 15 and the second rim part 16. On the semiconductor substrate 10, the passivation film 20 can be formed, and in that case, a resin layer can be formed on the passivation film 20. Further, for the passivation film 20, the previously explained content can be applied. The semiconductor substrate 10 can be a semiconductor or a semiconductor wafer. If the semiconductor substrate 10 is a semiconductor wafer, a plurality of semiconductor devices can be manufactured in one lot, and thus, semiconductor devices can be manufactured efficiently.

[0016]

In the present embodiment, the resin layer 30 is formed so as to overlap the second rim part 16 of the electrode 14, leaving out the area from the periphery of the semiconductor substrate 10 to the first rim part 15 of the electrode 14. The resin layer 30 can be formed leaving out the middle part of the intermediate part 17 of the electrode 14. The resin layer 30 can be formed so as to overlap the rim part 19 of the intermediate part 17 of the electrode 14. Or, the resin layer 30 can be formed so as to not overlap the rim part 19. If the semiconductor substrate 10 has the passivation film 20, the resin layer 30 can be formed leaving out the exposed part 18 of the electrode 14. For example, the resin layer 30 can be formed by providing resin exclusively in a predetermined region. Further, the resin layer 30 can be formed by forming a resin layer on the whole surface of the side of the semiconductor substrate 10 where the

electrode is formed, and by later removing an unnecessary part. In this case, part of the resin layer can be removed by photolithography technology, or etching, for example.

[0017]

Following, the wiring 40 is formed. The wiring 40 is formed so as to reach from the electrode 14 to the top of the resin layer 30. The wiring 40 can be formed by any previously publicly known method. For example, the wiring 40 can be formed by sputtering, or by applying the additive method forming the wiring 40 with nonelectrolytic plating. Or, the wiring 40 can be formed by spreading a conductive paste by inkjet method.

[0018]

Finally, the external terminals 46, the resist layer 50, the coat layer 60 and the like are formed. If the semiconductor substrate 10 is a semiconductor wafer, the substrate is cut into each individual semiconductor device 1, thus completing the semiconductor device 1 according to the present embodiment. FIG. 3 shows a circuit board 1000 onto which the semiconductor device 1 according to the present embodiment is mounted. Further, as examples of electronic equipment including the semiconductor device 1, FIG. 4 shows a notebook type personal computer 2000 and FIG. 5 shows a mobile phone 3000.

[0019]

Furthermore, the present invention is not limited to the embodiment detailed above, but rather allows for a variety of variations. For example, the present invention includes constructions that are substantially identical to the construction explained in the embodiment, (for example, identical construction regarding functions, methods and results, or objectives and effects). Further, the present invention includes constructions wherein the part that is not essentially of the construction explained in the embodiment has been changed. Further, the present invention includes constructions that have the same effect of usage, or achieve the same results as the construction explained in the embodiment. Further, the present invention includes constructions as explained in the embodiment to which publicly known technology has been added.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[FIG. 1] FIG. 1 is a view showing a semiconductor device according to an embodiment of the present invention.

[FIG. 2] FIG. 2 is a view showing a semiconductor device according to an embodiment of the present invention.

[FIG. 3] FIG. 3 is a view showing a circuit board on which a semiconductor device according to an embodiment of the present invention is mounted.

[FIG. 4] FIG. 4 is a view showing electronic equipment having a semiconductor device according to an embodiment of the present invention.

[FIG. 5] FIG. 5 is a view showing electronic equipment having a semiconductor device according to an embodiment of the present invention.

[Reference Numerals]

10 Semiconductor Substrate

12 Integrated Circuit

14 Electrode

15 First Rim Part

16 Second Rim Part

20 Passivation Film

30 Resin Layer

40 Wiring

FIG. 1

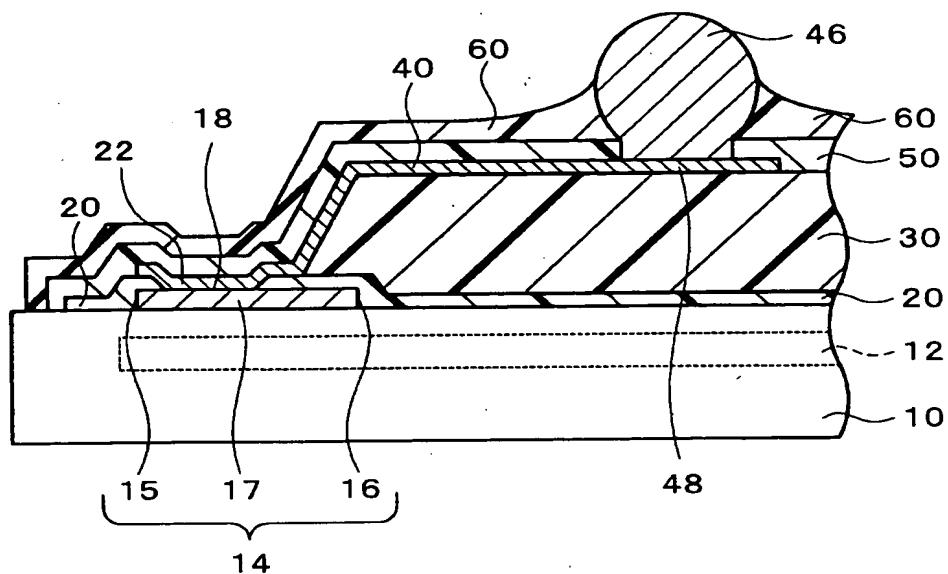


FIG.2

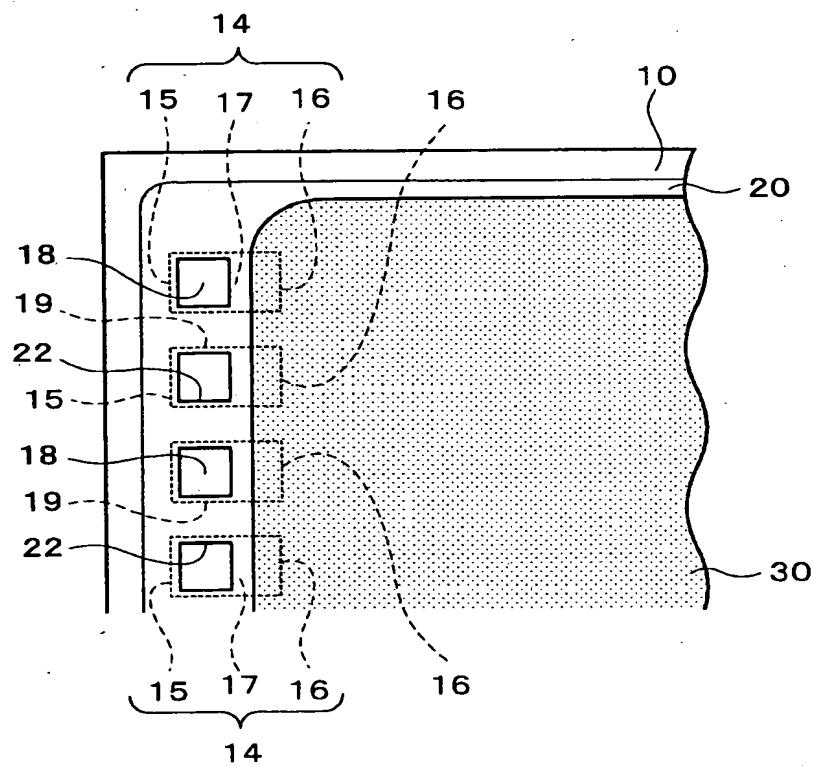


FIG.3

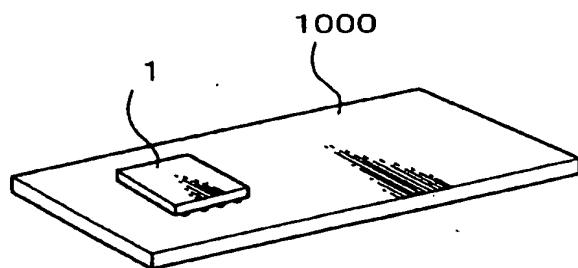


FIG.4

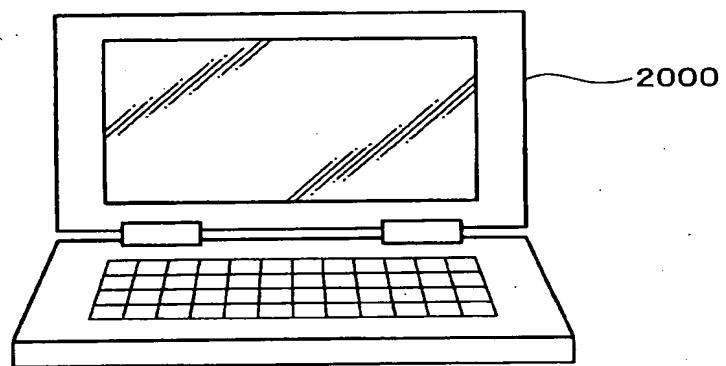
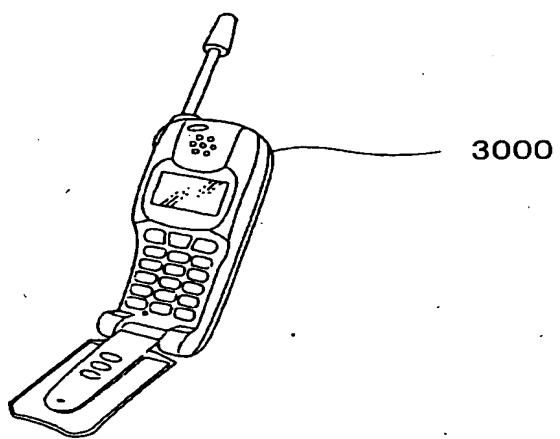


FIG.5



[Document] Abstract

[ABSTRACT]

[Problems]

The present invention is intended to provide a semiconductor device with high reliability and a method for manufacturing the same, a circuit board and electronic equipment.

[Means to Solve the Problems]

A semiconductor device according to the invention includes a semiconductor substrate 10 having an electrode 14, a resin layer 30 provided on the side of the semiconductor substrate 10 where the electrode 14 is formed, and a wiring 40 formed on an area reaching from the electrode 14 to the top of the resin layer 30. The electrode 14 has a first rim part 15 facing the periphery of the semiconductor substrate 10, and a second rim part 16 facing the center of the semiconductor substrate 10. The resin layer 30 is formed so as to overlap the second rim part 16, leaving out the area from the periphery of the semiconductor substrate 10 to the first rim part 15 of the electrode 14.

[SELECTED FIGURE]

FIG. 1